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Knowledge, Place and Power: Conceptualising Value Creation in Knowledge-Based Commodity Chains

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ABSTRACT

The knowledge economy has come to dominate much of policy discourse in the European Union with a particular emphasis in the *Lisbon Agenda* on becoming the leading 'knowledge-based economy' in the world by 2010. Such objectives are underpinned by the argument that knowledge and learning are central components of innovation and therefore competitiveness. Consequently the promotion of knowledge, learning and innovation are seen as unqualified goods. However, such processes are dependent upon their position within different places and across different scales because such relationships enable the creation and capture of value from knowledge-based commodities such as those derived from modern biotechnology and the broader life sciences. This paper conceptualises this relationship between knowledge and space by considering how knowledge-based commodity chains are positioned within particular places and across different scales.

1. INTRODUCTION

The concept of the *knowledge economy* or its variants such as the *knowledge-based economy* have come to dominate policy debates in many developed countries, especially in the European Union where the *Lisbon Agenda* explicitly concerns turning the EU into the leading 'knowledge-based economy' in the world (EC 2000). A new report for the Directorate-General for Research titled *Taking the European Knowledge Society Seriously* highlights the ambiguity inherent in the underlying rationale behind such policies, not least because of the conceptual paradigm that underpins the views on knowledge, learning and innovation (EC DG Research 2007). However, the emphasis on knowledge-based development has a long pedigree in policy-making and academic research stretching back to at least the mid twentieth century (see Godin 2006). Consequently knowledge and innovation, in particular, and more recently learning have come to represent the core processes explaining economic development and, more specifically, regional development in Western countries. Furthermore, they have come to represent the means by which developing countries can best achieve economic growth.

The centrality of innovation to economic development is nowhere clearer than in the debates around the biotechnology industry. Originating in scientific advances in the 1970s like recombinant DNA and monoclonal antibody research, biotechnology has been regarded as a wellspring of new technologies and economic growth for at least 30 years (see ACARD *et al.* 1980; House of Lords 1993; Wright 1993). Recent policy initiatives by both the European Commission and Organisation for Economic Co-operation and Development on the *bioeconomy* mean biotechnology remains a highly relevant consideration amongst policy-makers, non-government organisations and academics alike (EC 2005; OECD 2006). However, despite the sometime

overblown rhetoric that surrounds biotechnology – e.g. saving both our economies and health (see BIGT 2003) – a number of voices have raised questions regarding its contribution to both economic development and healthcare (see FDA 2004; Arundel and Mintzes 2004; Nightingale and Martin 2004; Joppi *et al.* 2005; Hopkins *et al.* 2007). In light of these concerns it is worthwhile to consider what processes contribute to the creation of economic value from biotechnology, leaving aside the trickier question of social value.

To do this I will focus on the importance of knowledge, place and power in the knowledge economy, and especially the geographical basis for these processes. To start with I will outline the origins of the knowledge economy thesis before considering the specific differences between knowledge, learning and innovation in relation to economic development. Here I outline the reasons for focusing on knowledge, place and power in the production of economic value in order to highlight the differences between regional and global processes and the need to go beyond the current emphasis on regional processes at the expense of global ones. Next I will examine the academic literature on global processes including commodity chain, value chain and production network analyses. The aim here is to illustrate the importance of such global processes and their connection to regional development, especially in developed countries where technological upgrading can still be an issue for some locations (e.g. old industrial regions). In reviewing this literature I will outline how I conceptualise the relationship between regional and global processes, which is the focus of the last two sections. The first of these will deal with how knowledge is embedded in specific places and, therefore, how value is produced from the co-operation encouraged at this scale by horizontal relationships between firms. The final section will then consider how place is embedded in knowledge as a

consequence of power asymmetries that are reproduced through global discourses that seek to eliminate local differences through the abstraction of standardisation. Finally I will conclude by considering how the current production of value from both regional and global processes in the knowledge economy can prove detrimental to the very knowledge industries they seek to encourage. Throughout I will focus on biotechnology as an example of the knowledge economy and draw in examples where relevant from this industrial sector.

2. THE KNOWLEDGE ECONOMY

2.1 Old or New, Concept or Policy?

The concept of the *knowledge economy* or *knowledge-based economy* can be traced back to the 1950s and 1960s when the discussion of knowledge in economic development first came to prominence (for reviews see Sokol 2004; Godin 2006). Although Joseph Schumpeter had argued that innovation was central to capitalism prior to this, especially in terms of periodic 'gales of destruction' that reconfigured the economic landscape, it was the work of scholars like Robert Solow and Fritz Machlup in the 1950s and 60s who theorised the importance of such processes at a societal level. The former highlighted the impact of technological change to economic growth, whilst the latter specifically identified a significant proportion of the US economy as attributable to 'knowledge industries'. Consequently the knowledge economy thesis can be seen as driven by both theoretical and policy concerns in that it centred on the argument that developed economies have moved towards high value-added sectors – due to lower labour costs in developing economies – and therefore these have to be supported and promoted to ensure economic growth.

The broad definition used by Machlup, however, was both inconsistent, in that it combined diverse sectors both public and private, and overly optimistic. For example, by the 1970s the growth of 'knowledge industries' in the US had reached a plateau (Brint 2001). At this point the American social theorist Daniel Bell (1973) presented a more general argument envisaging a change from industrial to *post-industrial society*. Such a society would increasingly depend upon the service sector and especially upon scientific (or theoretical) knowledge and high technology industries (see Brint 2001; Thompson 2004). This shift was theorised by others especially in the Regulation School (e.g. Aglietta 1979) as a shift from Fordism (i.e. mass production manufacturing) to *Post-Fordism* (i.e. flexible specialisation). More recent theories have focused explicitly on the introduction of information and communication technologies (ICTs) and their impact on social and economic organisation leading to the idea of an *information society* (see Castells 1996) or *new economy* (Rifkin 1996).

The preceding discussion helps to position current policy discussions in a broader set of resurgent concerns. In particular the interest in the *knowledge-based economy* (OECD 1996) can be seen as a specifically European phenomenon in that it combines the particular US focus on the importance of science and innovation to the *knowledge economy* and the more European emphasis on the social basis of knowledge in the *learning economy* (Lundvall 1996). At the European supranational level the promotion of the 2000 Lisbon Agenda and its goal for Europe to become "the world's leading knowledge-based economy" by 2010 has prioritised the application of scientific knowledge to ensuring economic competitiveness. In the national British context these concerns have been evidenced in government documents such as *Our Competitive Future*, *Building the Knowledge Economy* and

Learning Age (DTI 1998; Goddard and Chatterton 1999). Here the focus on "the more effective use and exploitation of all types of knowledge in all manner of economic activity" precedes the EU initiative (DTI 1998), but also illustrates governmental concern with knowledge and its exploitation.

Such policy emphasis has been driven by concerns with economic competitiveness and social cohesion, although the "European social model" is meant to 'adapt' to the new imperatives of the knowledge-based economy (EC 2000: 8). The difference from previous theories is the focus on people in terms of human capital and their contribution to knowledge production, transfer and exploitation. For example, the OECD (1996: 11) argued that whilst knowledge is 'abundant' its use is more problematic entailing an investment in the science base to enable innovation. These arguments raise serious questions about how we define knowledge, learning and innovation; how we conceptualise the link between innovation and economic development; and how we explain the knowledge and spatial processes that underpin value creation..

2.2 Knowledge, Learning and Innovation

The first issue to consider is how to distinguish between the concepts of knowledge, innovation and learning. To start with it is crucial to delineate *information* and *knowledge*. The former represents a 'message' that both the originator and receiver can understand (Cooke 2004) in that there is a clear(ish) interpretation of meaning that both parties are aware of. In this sense, information pertains to specific stocks of existing understanding (e.g. tangible and intangible artefacts like posters, leaflets, statistics etc.) about something rather than the collection, interpretation or storage of new understanding. In contrast, according to Burton-Jones (1999: 5) knowledge

represents “the cumulative stock of information” alongside its collection, interpretation and dissemination. Thus knowledge concerns how people collect, sort, absorb, interpret and organise knowledge or “all cognitions and abilities that individuals use to solve problems, make decisions and understand incoming information” (Doring and Schnellenbach 2006: 377).

Knowledge is a *system of thought* in that it enables the patterning and processing of information within a paradigmatic perspective. It therefore represents more than the skills or abilities of individuals because it involves the continuous accumulation of information that outlasts individual people’s involvement and is embedded in specific institutional and organisational structures (e.g. universities, firms). However, individual people retain a central position within the ‘knowledge economy’ because of the importance of *learning* in enabling the production, absorption and transfer of knowledge. New or unfamiliar knowledge is often hard to codify because it is *tacit* and therefore necessitates ‘synthetic’ practices as opposed to ‘analytical’ principles (Polanyi 1967; Cooke and Leydesdorff 2006). Tacit knowledge can be more explicitly defined as the process of learning in that it relates to individual experience rather than systems of understanding, although this is not to suggest that the systemic context of individual practice has no impact on learning (see Ernst and Kim 2002). However, it is because there are various and diverse ways that learning can occur that makes it distinct from the overall system; for example, learning involves – amongst other things – doing, using, trying, interacting, borrowing and failing (see Malecki 1997: 59).

Learning is central to knowledge and therefore central to the knowledge economy, but it does not explain how knowledge produces economic development or growth. Instead this is a consequence of *innovation* or “the transformation of

knowledge into novel wealth-creating technologies, products and services through processes of learning and searching" (Asheim and Coenen 2006: 149). Innovation is distinct from invention in that it concerns the attempt to carry out knowledge in practice entailing the capacity for understanding the world (ands its representations) alongside the individual and organisational capability to learn from practice. Furthermore, in neo-Schumpeterian theories there are different types of innovation representing new processes and new products – or *incremental* and *radical* change – that result from (and impact on) particular systems of innovation (Malecki 1997; Fagerberg 2005). Thus radical innovation entails revolutions in technologies leading to dramatic changes in economies, such as the purported 'biotechnology revolution', whilst incremental innovation contributes to existing technological regimes.

Although innovation has been cast in systemic terms involving internal firm capabilities, external actors like universities and government along with market dynamics, the relationship between knowledge and economic development requires the consideration of spatial dynamics as well. In particular the uneven spread of innovation – in terms of organisations and institutions – will have a direct bearing on the capacity of specific places to adapt to or initiate new technological regimes, whilst existing capacity will impact on the expansion of current regimes. However, the relationship between space and innovation is not limited to the consideration of just one scale. Thus it is important to explore how innovation systems are embedded across different scales (see Fromhold-Eisebith 2007) and what this means for knowledge, learning and innovation (Ibert 2007).

There are numerous analyses of innovation and regional economic development that have been called *territorial innovation models*. I will discuss aspects of these in more detail later, so for now it will suffice to outline their theoretical

trajectory. Drawing on Lagendijk (2006), it is possible to argue that research on regional innovation was initially focused on the structural and organisational features of specific locations. The focus on *functional* dynamics meant that external economies and economies of scope (i.e. production distributed amongst numerous, complementary firms) were highlighted as crucial. Subsequent research sought to extend this economistic perspective by drawing on social and institutional explanations for regionalised innovation representing a set of *relational* theories. The emphasis here was on understanding how the social collective helps to embed innovation in certain places through local networking and trust. Finally, the cognitive model specifically focuses on knowledge creation in terms of 'communities of practice'. Such *associational* processes help to explain how knowledge is transferred across organisational boundaries through the co-operation of actors in different organisations (e.g. local buzz). Overall these theories help to highlight the important economic, social and cognitive characteristics of innovative regions, although the lacuna at the heart of these theories is the overly deterministic focus on localised interactions and relationships at the expense of other scalar processes.

For this reason it is necessary to consider how different national systems of innovation and varieties of capitalism impact on regional processes (Lundvall 1992; Hall and Soskice 2001). Largely deriving from political economy and sociological theories, these approaches emphasise the national specific features of both capitalist and innovation systems in terms of institutional arrangements such as social rules, political action, public research, and so forth (Hayter 2004; Fagerberg 2005; Peck and Theodore 2005). However, it is not just the existence of these systemic features that provides an impetus (or not) to innovation, it is also the complementary fit of these different institutions with one another. For example, it has been argued that liberal-

market economies (i.e. Anglo-American) are more suited to radical innovation, whilst coordinated-market economies (i.e. Rhinish) embed a more incremental innovation system (Cooke 2004). The consideration of the national scale helps to position the regional analyses within a broader economic framework that accounts for the historical institutionalisation of specific arrangements between different social institutions. So even where regional institutions may encourage specific forms of innovation and regional economic development, these are constrained by national structures like industrial, labour market and regulatory policy (see Hart 2002).

Alongside considering the national scale, it is also increasingly important to integrate the global scale into an understanding of the relationship between innovation and economic development. This does not mean adopting the unsophisticated convergence or homogenisation perspectives of 'globalists' (Vertova 2006), but rather interrogating how global processes are tied into regional and national ones. Although there have been arguments that national states have been hollowed out by global processes (MacLeod and Goodwin 1999), there have been criticisms of such arguments for ignoring the continuing relevance of national business systems (Whitley 1998). It is therefore more important to understand how the transnational activities of firms have enabled the creation of both intra-firm and extra-firm relationships across different countries. Whether globalisation conceived as the functional integration of such activities across national borders is actually closer to internationalisation (i.e. interaction across borders) is beside the point when considering the impact that such activities have on those organisations concerned. Thus, as Bunnell and Coe (2001) have argued, innovation is not limited to a particular scale, but stretches across the region, nation and globe requiring that an adequate

approach to understanding these processes and economic development must be underpinned by a multi-scalar outlook.

A multi-scalar approach provides the means to consider how (economic or instrumental) value is created from both knowledge and spatial processes (social or ethical value), especially in industries reliant on knowledge, learning and innovation (see Lee 2006). Central to this position is an understanding of markets that draws from research outside of mainstream economics and does not confuse the distinction between normative and analytical models of human behaviour. Rather, value is constituted by the "interaction between individual and social processes" (Moulaert and Nussbaumer 2005: 2079) in that the social context determines the circulation and accumulation of goods through the production of scarcity and thereby the replacement of subsistence with 'choice' through market exchange (Polanyi 1957). As such, economic value is always dependent on the *movement of things*: the production line, the supply chain, distribution channels, retail space, personal consumption, waste disposal etc. Even where technology (e.g. ICTs) has replaced previous patterns of activity (e.g. personal communication) as some argue has happened with the move towards a 'technological economy' (Barry and Slater 2005), movement is still central because such technologies enable different modes of operation rather than new modes of activity. Thus space, place and scale represent sites and modes of embedding that enable markets to create economic value (Krippner 2001), as well as representing the sites of social value creation (Lee 2006).

In the particular case of the knowledge economy – leaving aside the question of whether such a concept is adequate to explain current political-economic conditions – spatial and knowledge processes lead to the simultaneous and co-dependent concentration and dispersal of innovation. Because markets are only

necessary where there are novel (i.e. uncertain) phenomena – otherwise there would no need to foresee "the future states of preferences, resources and technologies" (Harvey and Metcalfe 2005: 2) – innovation and technoscientific change are themselves constituted by space, place and scale. Here the *spatio-temporal fix* theorised by David Harvey helps to explain the creation of (economic) value (see Jessop 2004). It is through the concentration of innovation in particular places that enables value capture, whilst its dispersal enables the financially viable deferment of value capture in the future. I will discuss this in more detail below so I will only briefly say here that value creation from the concentration of innovation depends upon the specific knowledge attributes of place and its inhabitants, whilst value from the dispersal of innovation comes from the standardisation of materiality at different scales through the exercise of power. In Patrik Aspers' (2007) terms, the former represents a status-based, switch role market in which actors determine value, whilst the latter represents a standard, fixed role market in which contracts or material conditions (e.g. the commodity) matter. Furthermore, the materiality of scalar value relationships depends on the production of *virtual* abstraction to erode diversity and difference represented by concentrations to enable exchange (see Carrier 1997; Miller 2003). Thus value creation is mediated by knowledge and spatial processes that operate, respectively, across space and scales and within different places. In order to explore this argument it is important to consider the current methodological and ontological approaches exploring multi-scalar value relationships such as the theories of global commodity chains (GCC), global value chains (GVC and global production networks (GPN).

3. GLOBAL PROCESSES UNDERPINNING KNOWLEDGE, PLACE AND POWER

There has been considerable interest in the globalisation of economic activity in the social sciences from management studies and economic sociology through to economic geography as evinced in the *Global Value Chain* programme established by Gary Gereffi and others at Duke University.[i] As mentioned above, it is based on the perspective that globalisation represents more than merely the international spread of economic activity. As Peter Dicken (2003b: 30) argues, it is rather the functional integration of activity across borders and particularly "the power to co-ordinate and control operations in a large number of countries (even if it [firm] does not own them)". However, whilst bearing this point in mind, Dicken (2004) also stresses that it is important to avoid treating globalisation as a 'causative' concept or process. Consequently it is important to explore how the globalisation of economic activity has both come about and how it is managed.

The relevance of such research is further reinforced by the continuing claims that global economic homogenisation is not inherent, but rather that the national organisation of firms and institutions still impacts on the production of value (see Whitley 1996, 1998; Coe and Yeung 2001). Furthermore, the regional dimension of such organisation is increasingly important when considering the concentration of specific types of activity or sectors in certain locations around the world. Thus the overarching aim of this paper is to explicate both how knowledge is embedded in certain places and how power is played out across those places through examining 'global' socio-economic approaches. A concomitant aim is to apply this analytical discussion to the knowledge economy rather than the more usual focus on developing countries.

3.1 Global Commodity Chains

The initial impetus behind such research was the political economy work on *world-systems* by Hopkins and Wallerstein and the international business analysis of value chains. Much of the later work on commodity chains originated in the former before moving towards the value chains approach in the latter; the term 'commodity chain' was itself coined by Hopkins and Wallerstein in 1977 (Bair 2005: 155). The world-systems approach looked at the transformative effects of international trade on early modern production especially focusing on the wheat and shipbuilding trade in Europe prior to 1800 (Hopkins and Wallerstein 1986). In so doing, they conceived of the world-system of production as consisting of an "interzonal movement" from peripheral areas to the capitalist core drawing on dependency theory and a Braudelian historical perspective (Hopkins and Wallerstein 1994). As such they regarded the concept of national development as problematic because of the inter-dependencies across the system (Bair 2005). However, they also highlighted how technological and organisational change can reconstitute nodes within the commodity chain because the "boundaries [of the production process] are socially defined" (Hopkins and Wallerstein 1994: 18). Thus knowledge and innovation impact on the processes that constitute the chain and provide an important input into the social boundaries that distinguish and link different nodes.

The management literature on *value chains* focused more on firm-level strategy, particularly the internal organisation and performance of activities. One such example is the work of Michael Porter (1990) on the "discrete activities" within a firm from logistics through to support services like human resources management. Firms produce value through either performing activity more efficiently or uniquely,

meaning that innovation (and the knowledge necessary for it) plays a central role in competition. Advantage is derived from an interconnected system, which includes new products, processes and inputs all linked together across the value chain. However, the value chain can also be applied to industrial sectors through the inter-linkages between supplier, distributor and buyer value chains that connect with an individual firm leading to the concept of the *industrial cluster* (Porter 1990, 2000, 2003). Consequently the cluster provides a useful analytical tool for exploring how factor conditions, competition and rivalry can stimulate innovation in a firm, although there the empirical support for such 'localised' effects of clustering are less clear than the theoretical position contends (see Malmberg 2003; Malmberg and Maskell 2005).

The *global commodity chains* approach derived from these the two theories outlined above was stimulated by the globalisation and internationalisation of business which its main proponent – Gary Gereffi (1994, 2001b) – argued was a consequence of 'open' trade, new technologies, changing transport and investment by transnational corporations (TNCs). These factors provided the means to both spread out business activities and integrate these dispersed activities across national borders (Gereffi 1994, 1999). According to Gereffi (1994, 1996), the global commodity chains concept represents a useful approach for understanding this phenomena because it covers four main features of global activity. First, each GCC consists of different organisational systems that cut across spatial boundaries, but does not privilege one above others. Second, it enables the analysis of local, national and global linkages rather than being restricted to a particular scale. The third aspect is the most crucial concerning governance structures, especially the difference between supplier-driven and buyer-driven GCCs (Gereffi 1994, 1996, 2001a, 2001b).[ii] It is important to note here that the GCC approach focuses explicitly on developing

countries and their capacity to upgrade, which determines the conceptualisation of governance. Finally, the GCC approach involves a consideration of the institutional variation between sectors and locations (Gereffi 1996), although this was largely a later addition to the theory following criticism from the business systems perspective (Henderson 1996; Whitley 1996).

Although the GCC perspective provides a useful means to address national development outside of the global economic periphery, it is not oriented towards examining the global knowledge economy. First of all it is concerned predominantly with 'commodities' or finished goods rather than services or intangible products such as pharmaceutical drugs. Second, the emphasis on upgrading in developing countries means that the emphasis on knowledge-based development in developed countries is sidelined. Third, the focus on production means that it is conceptually linear (see Smith *et al.* 2002), which means it cannot account for the complex collaborative arrangements or alliances operating in industrial sectors like biotechnology between diverse organisations (not just firms) and the consequent power disparities. For example, the growing importance of small biotech firms to the pharmaceutical industry means that there is no simple one-way governance of the network linkages, but rather the need for a more sophisticated *alliance*d-based governance (see Birch 2008; also see Pisano 2006). Third, the territorial approach does not adequately address the importance of regional processes such as specific localised institutional structures, or the interaction between such regional institutions and those at the national or global scale (Smith *et al.* 2002). Finally, the treatment of regulation does not acknowledge the 're-regulation' of markets alongside the de-regulation of trade, which means that the GCC approach tends to treat global competition as the result of innovation, networks and regulations (Raikes *et al.* 2000), ignoring the important role

of the state in stimulating and supporting certain knowledge dependent sectors such as biotechnology (Birch 2007).

These problematic features of the GCC approach have not been addressed in the more recent move towards *global value chains* (GVC) (Gereffi 2001a; Sturgeon 2001; Gereffi *et al.* 2005). In part, Bair (2005) suggests that this may be because such theories have abandoned the holism of world-system theory with its emphasis on inter-dependence and, instead, they have stressed the development role inherent in both GCC and GVC analysis. This is why so much of the research concentrates on governance – to the detriment of understanding organisational structure, territoriality and institutions – especially in the rather restrictive GVC theory. Consequently the shift from GCC to GVC concepts can be seen as a new focus on the "internal logics of sectors" over "external factors" (Bair 2005: 164). The connections with earlier value chain analyses by Porter (1990), for example, are evident, since the sectoral focus of GVC loses some of the uniqueness of the original GCC approach; i.e. the stress on external linkages, the uneven spread of globalisation and the inter-sectoral variation and dynamic (Gereffi 1996). Furthermore, the restrictive, transaction cost based sense of governance propounded in GVC theories limits the ability of researchers to explore the specificity of particular places or the importance of different geographical scales, whilst simultaneously treating sectors as coherent despite national differences in business systems (Whitley 1996, 1998).

3.2 Global Production Networks

The limitations of the GCC and GVC approaches focus on sectors is more evident when considering knowledge-based and driven sectors because the emphasis on a vertical sequence of events and activities obscures the nature and extent of these

relationships; something which the *global production network* (GPN) work in economic geography seeks to explore (e.g. Dicken *et al.* 2001; Henderson *et al.* 2002; Coe *et al.* 2004; Hess and Yeung 2006; Coe *et al.* 2007; Rodrigue and Hesse 2007). One central claim of GPN scholars is that state-centric analyses of economic development are problematic – echoing world-system theory – and that power, context and territoriality need to be built into understanding multi-scale processes (Henderson *et al.* 2002). Although concerned with 'networks' the GPN approach uses a less restrictive sense of this term than that associated with transaction cost economics. In particular, the interest in Schumpeterian forms of competition – that reliant on collaborative strategies (Hudson 2002) – leads to the conceptualisation of network relationships in systemic terms. This enables researchers to go beyond the linear understanding of economic integration inherent in the GCC concept, providing the means to analyse iterative flows between organisations and not just firms (Smith *et al.* 2002). Thus knowledge and learning can be introduced into the analysis as Ernst and Kim (2002) illustrate with their discussion of the conversion of tacit-explicit knowledge through processes such as socialisation, combination, externalisation and internalisation. Another benefit of the GPN approach is that the use of networks as a methodological and analytical tool enables the theorisation of multi-scale institutional frameworks (Dicken *et al.* 2001), alongside the rejection of simplistic local-global dichotomies (Henderson *et al.* 2002). Consequently it can incorporate globalisation and regional development through emphasising "endogenous institutional structures" with "inter-firm networks and global commodity/value chains" (Coe *et al.* 2004: 468).

However, despite these advances over GCC and GVC theories, the GPN adherence to network analysis raises a number of issues. First, and like other network theories, it can lead to the relational structure (i.e. network) representing the

explanation for the processes under consideration. For example, ontologically a network includes all relevant actors (human and non-human) within its remit, but it is difficult to delineate actors and identify their importance since everything is inter-related from national states to internal firm capabilities. Second and linked to the last point, networks tend to flatten relationships, which means that the importance of scale can be lost even though multi-scalar relationships are highlighted (Bunnell and Coe 2001). Third, the systemic focus of GPN theories (and others) can lead to the suppression of human agency, especially because of the productionist bias, and culture highlighted by academics focusing on *circuits of culture* (see Hughes 2000; also Leslie and Reimer 1999). Such scholars, drawing on Appadurai (1986) and the 'social life of things', emphasise the non-linear circuits of production, distribution and consumption. In this sense, knowledge contributes not only to production, but also constitutes the cultural meanings and values attributed to commodities and their circulation through codes, standards and regulation (see Hughes 2006). Finally, the GPN perspective is most useful when applied to mature industries where there are clear relationships and modes of operation. In contrast, emerging industries like biotechnology cannot be neatly fitted into the network frame because they involve shifting and ambiguous linkages and relationships between diverse organisations.

So, in order to conceptualise the knowledge economy under global conditions it is necessary to draw from across these theories in order to analyse the *knowledge-place dynamic*. Furthermore, to understand how value is produced from this dynamic it is necessary to explore how global integration has, somewhat paradoxically, enabled the dispersal of activities across regions (Ernst 2002). Consequently it is necessary to consider what impact the "strategic coupling" of global (or transnational) commodity chains and production networks with regional economic systems has on

both knowledge creation and the power asymmetries that produce value through relationships mediated by place, space and scale (Coe and Hess 2006). Furthermore, it is important to consider not only how knowledge is embedded in place and scale – i.e. dispersed across regional and national economies – but also how place and scale are embedded in knowledge – i.e. global discourses (Olds and Thrift 2004; Leyshon *et al.* 2005) and master-narratives (EC DG Research 2007). Both these processes create value, one dependent upon vertical relationships and the other horizontal ones, but without the latter there is little encouragement for regional development and upgrading in the knowledge economy. Thus the focus of the next two sections is on how both knowledge and power produce value and how different processes across place, space and scale enable or constrain the organisation of economic activity. TO do so I will adopt the commodity chain as a methodological unit of analysis over the production network, whilst introducing the features of the GPN framework that are missing from GCC analysis; namely the multi-scalar focus on territorial variation, institutional difference and power asymmetries.

4. THE *KNOWLEDGE-PLACE DYNAMIC* IN THE PRODUCTION OF VALUE

The strategic coupling of global chains and networks with regional systems entails a reconsideration of work on localised knowledge, learning and innovation. Implicit in this discussion is the position that socio-economic activity is more than the attributes of actors (e.g. firms, entrepreneurs), it encompasses “patterns of relations” as well, or the overall picture (Grabher 2006: 173). In this sense, I aim to not only moved beyond the individual reductionism of economics, but also the focus on material and social

conditions in regional studies and economic geography. Consequently I will build upon analyses that stress the importance of interaction and *associationalism,* for want of a better word. By doing so I do not wish to disparage previous regional research, but rather stress that to take multi-scale processes seriously we need to consider how relationships and interaction differ at different scales and across different places. Thus the embedding of knowledge in specific places is subject to patterns of interaction across scales and places that cannot be explained by the material and social conditions of those places alone.

4.1 Place and the Embedding Knowledge in Space

As mentioned above, existing regional research on knowledge, learning and innovation – territorial innovation models (TIMs) – can be split between *structural-organisational*, *social-institutional*, and *cognitive* theories (see Lagendijk 2006; also Moulaert and Sekia 2003; Simmie 2005). Rather than presuming the cause from the effect, like much regional research, it is important to consider how knowledge contributes to regional innovation and, in particular, how it is embedded in specific places.

The first of these is particularly associated with theories on Schumpeterian long waves of technological change, transaction cost economics and flexible specialisation. Here the disintegration of vertical relationships in industrial production induced by technological, organisational and territorial changes enable a shift from Fordist mass production to Post-Fordist production processes in which the distributed activities of firms produce external economies and economies of scope in particular places (Lagendijk 2006). Therefore knowledge, learning and innovation are tied into particular organisational forms (i.e. local distributed production systems) and the

structural features of the region such as a flexible, skilled labour force (Simmie 2005). Although influential in the 1980s, these theories were superseded by research that stressed the importance of relational processes in regions.

The second set of theories covers a broad range of concepts from 'regional innovation systems' (Cooke 2004) through to 'institutional thickness' (Amin and Thrift 1992). Such theories incorporated important concepts from economic sociology such as *embeddedness* (Granovetter 1985) and *institutions* (see Campbell 1997) to examine the socio-cultural context of regional economies. These theories represent regional processes of knowledge, learning and innovation in social-cultural terms that highlight the relationships between regional firms, organisations and institutions. What this means is that these actors share a similar environment which enables collective responses to change, thereby emphasising the importance of the regional knowledge base and regional learning (Moulaert and Sekia 2003). These two latter concepts are based on the idea that tacit knowledge is hard to transfer and therefore necessitates localised face-to-face interaction as well as trust between actors, both of which entail shared local social and institutional similarity (MacKinnon *et al.* 2002; Lagendijk 2006).

The final theories consist of those that emphasise interaction over either material or social conditions. In particular, Nonaka and Takeuchi (1995) argue that the circulation of knowledge between different actors contributes to its development, and through such circulation regional actors' form 'communities of practice' or 'knowledge communities' characterised by shared systems of knowing (Pinch *et al.* 2003; Lagendijk 2006). Learning at the regional scale, therefore, entails the acquisition, absorption and diffusion of both tacit and explicit knowledge through socialisation, combination, externalisation and internationalisation (Ernst and Kim

2002). Both tacit and explicit knowledge are embedded in specific places because the former is constituted by the community of knowledge workers, whilst the latter is dependent upon the capability of knowledge workers to understand and apply it. Thus, as von Hippel (1994) argues, iterative interaction leads to the expansion and accumulation of new knowledge since each iteration leads to not only the development of new ways of knowing (i.e. tacit knowledge), but also the explicit by-products of this learning (i.e. codified knowledge such as patents). Innovation follows from the application of this new knowledge and learning as firms (or other organisations) seek to capture the value from new knowledge (Gertler 2003; Malmberg and Maskell 2006).

Although in this conceptualisation knowledge is embedded in specific places, it is also vital to consider how new knowledge can enter a localised and therefore closed system. Without such external additions, a regional knowledge community would only be able to work with existing knowledge and therefore be unable to adapt to non-localised events. This highlights the importance of extra-local connections and linkages to regional economies and explains why the empirical evidence of intra-cluster relationships is so weak (see Malmberg 2003; Malmberg and Power 2005). Thus the local 'buzz' generated by place-specific interaction has to be tied into global 'pipelines' through which new knowledge can be acquired and adopted into the localised system (Bathelt *et al.* 2004; Malmberg and Maskell 2005). The local-global connection is crucial and helps to explain why global integration can lead to the dispersal of innovation. Furthermore, it illustrates the importance of considering how scale impacts on such processes.

Although scale is a contestable concept in economic geography (see Marston 2000; Jonas 2006), it is still useful to consider the *operational scale* at which different

processes occur. In the case of capitalist markets and the capture of value from the knowledge economy, it is useful to consider the different ways that scale impacts on interaction. Rather than assuming that all markets operate in a similar fashion, for example, Granovetter (2002) argues that there is a distinction between horizontal and vertical relationships. The former represents the regional interaction in localised knowledge communities that firms engage in and helps to illustrate how regional advantage is produced by the dispersal of innovation. The latter will be discussed in the next section. Horizontal relationships are based on co-operation rather than compliance because they involve non-hierarchical interaction between firms (and other organisations) for whom the resultant trust enables these actors to collaborate with one another without the attendant fear of exploitation. In embeddedness terms, these firms are bound together by *strong* ties that encourage further interaction and discourage malfeasance (Granovetter 1985). Such relationships are possible where actors are spatially proximate (i.e. operate at the same scale) to one another because existing interaction and monitoring provides information on other actors that is less asymmetrical than vertical relationships since it is harder to 'block' knowledge flows at local scales.

Despite this structural argument about scale, it is also important to consider how co-operation is produced at the local scale. Local interaction and monitoring does not occur automatically, but accrues over time. Consequently it is important to consider how this occurs. The primary reason for co-operation is the existence of place-based institutions that produce a shared culture for actors within their locality; that is, "organized sets of constitutive relationships, expectations and cognitive frameworks" (Carruthers 1997). However, it is important to distinguish between institutional theories to avoid the overly deterministic and constraining concept of

institutions used in economics (i.e. rational choice) and some historical analyses (see Campbell 1997). More relevant for regional economies is *organisational institutionalism* which goes beyond the consequentialist preoccupation of the other two theories (Campbell 1997; Carruthers 1997). Instead the emphasis is on the 'appropriateness' of action within a particular frame of meanings and expectations, which benefits firms by making their actions sensible to other firms in the same setting (DiMaggio and Powell 2004). Thus institutions enable actors – individuals, firms, public organisations – to operate at a specific scale (e.g. regional) within a system that encourages co-operation constituted by shared values that makes each region distinct from any other.

Consequently the dispersal of innovation resulting from global integration leads to the production of numerous varied and diverse sites of innovation, all of which have specific institutional frameworks that enable and promote horizontal relationships. In such circumstances economic value is constituted by the role of each actor. The horizontal and co-operative relationships of the knowledge economy mean that value is derived from 'status' markets – rather than 'standard' ones – and from the 'switch-role' played by each actor (see Aspers 2007). The former represents markets in which the quality of the product cannot be separated from the status of the producer and usually refers to art or aesthetic goods. However, it can also apply to knowledge industries like biotechnology where the capabilities of the actors concerned (e.g. scientists) is central to the evaluation of a product (e.g. platform technology) since it is the tacit knowledge held by the producer that is valued (see Zucker *et al.* 1998). The latter represents a market where the identity of the buyer and seller is not set; a buyer can become a seller and vice versa. Again, the knowledge economy, especially with biotechnology, can be characterised in these terms as firms

draw on multiple knowledge sources for innovation and, in turn, provide knowledge to other innovators. Thus a biotechnology product or process relies on access to diverse, often excludable (Arora and Merges 2004), knowledge and at the same contributes to further knowledge production by other actors. Thus value creation depends on the status of the actors (i.e. their tacit knowledge) and the iterative interactions they maintain with others.

From this perspective it is possible to argue that value is derived from the practices of actors who are constituted by the local or regional scale and the specificity of place (see Lee 2006). This means that it is the diverse qualities inherent in particular contexts that enable the capture of value from the dispersal of innovation that follows the integration of globalisation. In particular, place and local scale provide knowledge-based firms with an advantage through access to diverse knowledge that helps to differentiate them from other place-specific firms because it is embedded in place. It is in this difference that they gain an innovation advantage because they are able to compete on uniqueness rather than price (as opposed to value) alone. However, the localised creation of value does not occur in isolation, as the previous section showed with the discussion of global commodity chains and production networks. Rather local economic activity is entwined with global processes that impact on and are, in turn, influenced by regional processes; in the midst we can also position national and supranational processes (e.g. national variations of capitalism; Peck and Theodore 2005). More specifically, because the knowledge economy is not dependent upon spatially embedded interaction and iterative learning alone, but also extra-local linkages, it is necessary for knowledge-based firms to access global knowledge. Thus place-specific processes are subject to global processes that are different in kind as much as scale, as I will discuss below.

4.2 Power and the Embedding of Space in Knowledge

The resurgent interest in regional economies and, in particular, regional knowledge, learning and innovation processes at the end of the twentieth century has been subject to criticism for an over-emphasis on the local at the expense of global (and national) processes (see MacKinnon *et al.* 2002; Phelps 2004). The empirical evidence underpinning this research has also been questioned with, for example, Malmberg (2003), Malmberg and Power (2005) amongst others questioning the relevance of cluster theory, in particular, and localised learning more generally (Malmberg and Maskell 2006). A number of scholars have theorised a distinct local-global relationship in which local processes are supplemented by global ones; for example, Bathelt *et al.* (2004) posit a 'local buss, global pipelines' relationship in which local tacit knowledge and learning draw upon global (usually explicit) knowledge. Others like Wolfe and Gertler (2004) suggest that localised knowledge relationships need to be placed within a broader context of global linkages, although also arguing that these multi-scalar linkages need not be considered in hierarchical terms. Thus the potential conceptual contribution of the global commodity chains, production networks and their ilk to these debates is important because they provide the means to theorise the relationship between local and global processes.

Some of this work has specifically focused on multi-scalar innovation processes, bringing together international, national and regional innovation system perspectives (e.g. Bunnell and Coe 2001; Coe and Bunnell 2003; see Vallance 2007). The focus on localised innovation is seen as too restrictive because it ignores the "linkages and interrelationships *between* and *across* these various spatial levels or scales" (Bunnell and Coe 2001: 577). However, in so doing these authors have moved

away from treating scales as discrete and adopted a network methodology focusing on the processes like the transnational migration flows of 'knowledge communities' (Coe and Bunnell 2003). Rather than adopt a network approach, I want to emphasise how different scales entail different processes that work together (across scales) to produce value. In particular, I want to show in this section how the global scale produces abstractions of value by embedding space in knowledge, especially in terms of global discourses of capital; e.g. 'cultural circuit of capital' (Olds and Thrift 2004). Thus knowledge is intrinsically tied to the "reconfiguration of value relations" (Smith *et al.* 2002), but through the discursive shaping of markets, economic value and meanings at the global and not local scale.

The global can be characterised as a scale at which *knowledge* about knowledge and innovation has become *virtual* in that it represents discursive abstractions of place-specific, and therefore localised, practices (see Carrier 1997; Miller 1998, 2003). Such global knowledge is distinct from local knowledge in that it seeks to replace specificity of diverse, disparate and varied local populations with a generalised set of interests (Miller 2003). In particular, "discourses of innovation" circulate through market reports, policy documents and academic research as well as through teaching and presentations by business experts (Bunnell and Coe 2003; Vallance 2007). This has been termed the 'cultural circuit of capital' by Nigel Thrift and concerns the production and distribution of business knowledge by "management consultants, management gurus and especially business schools" (Olds and Thrift 2004: 272; also see Leyshon *et al.* 2005). It serves two purposes: first, it reduces local practices to abstract, or *virtual*, prescriptions that can then be applied elsewhere and, second, it naturalises existing practices as sensible and therefore worthy of support. One such discourse can be identified in the instrumentalisation of science in the

'knowledge-based economy' narrative employed by the European Union in its 2000 Lisbon Agenda (see EC DG Research 2007). Here scientific knowledge is tied explicitly to a specific innovation paradigm based on the "economics of technoscientific promises" resulting from biotechnology and other new advances (*ibid.*). Thus global discourses serve to enrol support for government policy, financial investment and other processes that operate at a global (and national) scale.

There is a direct relationship between localised practices and global discourses that relates again to the issue of scale and the creation of value, marking out the global scale as distinct from the local – unlike the network perspective. Instead of horizontal interaction and co-operation through trust, global linkages can be characterised as vertical relationships reliant on compliance underpinned by power asymmetries (Granovetter 2002). Although the consequences are similar (i.e. both horizontal and vertical relations produce value), the mechanisms are distinct. Vertical relationships lack the strong ties at the local scale and are based on *weak* ties (Granovetter 1985), which enable the strategic coupling and decoupling of global and local processes (Granovetter 2002; Hess and Coe 2006). For example, weak ties connect two or more localised nodes together enabling them to access one another, so the connecting actor (e.g. a transnational pharmaceutical corporation) can block (or co-ordinate) the flow of knowledge between groups and create value in the process. This means that the alliance-based organisation of localised innovation is also tied into a power-based process that creates value by limiting access to knowledge. Thus value is derived from the global (i.e. vertical) construction of abstractions such as intellectual property rights (IPRs) and commodity standards (see Orsi and Coriat 2005; Prudham 2007) alongside the collaboration of actors which are linked horizontally.

Again institutional analysis provides a useful insight into how this is global process occurs. Vertical relationships based on power asymmetries can be seen as the consequence of a specific 'form of integration' based on exchange embedding locally constituted relationships and interaction – or place – in contract-based markets (Polanyi 1957; Smelser and Swedberg 2005). Instead of institutions – as modes of operation – however, it is the *institutionalisation* of global discourses on innovation that influence meanings and sets standards, constraining action within a 'logic of consequentiality' (Campbell 1997; Carruthers 1997). In this perspective, institutions shape the motivation of actors rather than representing strategies for achieving those goals. They do so by "shaping patterns of interaction, opportunity structures and the distribution of power" (Campbell 1997: 22) and result from struggles over group interests and ideologies. One such example drawn from biotechnology is the 'patent coalition' that sought to promote and embed intellectual property in the Uruguay Round of the GATT discussions that eventually resulted in the establishment of TRIPs by the WTO (see Tyfield Forthcoming). Thus the institutionalisation of particular interests through global discourses establishes a series of constraints on local innovation processes through the establishment of abstract meanings and standards.

This does not mean that local actors cannot themselves decouple from such global processes, but rather that value creation concerns both the local practices undertaken by these actors and the global discourses embedding these actors in their place. The creation of value in the latter case is, once again, a consequence of the positioning of actors in the market. Instead of the production of value from the status of the actor and their switch-role identity, however, value is derived from 'standard' markets where evaluation is made in reference to a commodity's material and

contractual conditions (Aspers 2007). These entail a separation of the commodity from the producer. Furthermore, the fixed role of market actors – in that sellers and buyers are distinct from one another although without precluding their position within a commodity chain – means that the value of a commodity results from the object itself rather than the actors involved. This means that value is dependent upon more formal relationships (e.g. contracts) necessitating the *abstract* standardisation of commodities through the institutionalisation of power asymmetries. For example, the development of the biotechnology industry was dependent upon the shaping of intellectual property rights so that value could be captured from scientific knowledge where before it could not (see Birch 2007; also Arora and Merges 2004; Coriat and Orsi 2005; Prudham 2007). Such processes are *virtual* (see Miller 2003) in the sense that they standardise contingent, contextually specific practices in abstract standards (e.g. patents, commodities) that are institutionalised at the global scale. Thus these markets depend upon power asymmetries because they necessitate the blocking of knowledge rather than the iterative process of local practices.

The preceding discussion illustrates how value is dependent upon global processes, most notably upon discourses that enable the abstraction of place specific and contingent practices. In so doing these discourses embed place – i.e. localised interaction – in knowledge and the *virtualism* of global economic processes that enable the global integration of local practices through the construction of similarity (as an abstraction). The vertical relationships attendant on such global processes provide knowledge-based firms with an advantage through power asymmetries in which diverse and contingent knowledges are standardised in particular institutional structures such as intellectual property, financial regulations and trade ‘re-regulation’. In so doing place is embedded in knowledge of such institutional structures because

firms become dependent upon understanding how to relate their own specificity and diversity with the abstract similarity necessary to create value from their activities (see Graeber 2001). Again, this means that global processes do not operate in isolation, but are dependent upon the difference entailed in local processes and the similarity that global processes produce. Thus the production of new knowledge through local practices (i.e. difference) does not produce value unless there is a corresponding standardisation of such knowledge through global discourse (i.e. similarity) to enable the comparative evaluation of new knowledge.

CONCLUSION

The importance that academics and policy-makers have placed on the knowledge economy has meant that interest in the relationship between knowledge and space has increased considerably in recent years. In particular, the promotion of technological innovation, especially in hi-tech sectors like the life sciences, has become an almost *de rigueur* objective in regional development across developed countries. The pursuit of competitive advantage in this area has suffused supranational, national and regional narratives, blending diverse conceptual concerns with policy objectives that often collapse the distinction between *ought* and *is*.

The aim of this paper was to conceptualise how value is created in the knowledge economy and, in particular, how value results from processes that are dependent upon space, place and scale. In turn this was meant to illustrate how these geographical concepts are themselves subject to knowledge processes. Thus not only is knowledge embedded in space, but space itself is embedded in knowledge. I drew upon the global commodity chains (GCC) and global production networks (GPN) literature to illustrate how local knowledge-space dynamics are distinct from global

knowledge-space dynamics in that the former are based on horizontal cooperative ties whilst the latter are based on vertical power-based ties.

Value is derived from local horizontal networks through collaboration between locally-specific organisations and institutions that both enable and encourage interaction between these social actors. In this context, knowledge is often ‘sticky’, hard to absorb and embodied in particular place-based actors, which means that these actors are valued for their attributes and capabilities. In turn global vertical networks produce value through the exercise of power in that one actor can coerce others to acquiesce to their demands. In order to understand how this happens, it is necessary to consider how knowledge in these circumstances is an abstraction of ‘sticky’ localised knowledge. Abstractions provide the means for social actors to embed such place-based knowledge in a universal framework that reduces the power of local actors and heightens the power of global ones. Consequently the establishment of global rules, regulations and standards enables these actors to capture the value inherent in multi-scalar relationships. Finally, it is important to note that neither local nor global ties operate in isolation. They are entwined and dependent upon one another, which means that an analysis of the knowledge economy and economic activity such as the life sciences necessitates a multi-scalar analysis.

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NOTES:

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[i] http://www.globalvaluechains.org

[ii] Supplier-driven GCCs represent the early investment-based phase of development (1950-70) in which export-based industrialisation dominated. In contrast, buyer-driven GCCs predominate in the trade-based phase of development (1970-95) when intra-firm trade came to dominate (Gereffi 2001a).

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